REMARKS

Claims 1 – 11 were pending in this application when last examined. Claims 1 – 11 were rejected in the Office Action dated September 22, 2004. Claims 1 – 5 are being amended. Claims 6 – 11 are being cancelled. Reconsideration is respectfully requested.

Claim Rejections – 35 U.S.C. §103

In sections 1 and 2 of the Office Action, the Examiner rejected claims 1 – 5 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,576,686 to Delme et al. (hereinafter *Delme*) in view of U.S. Patent No. 4,631,314 to Tung et al. (hereinafter *Tung*). Applicants traverse this rejection.

Claim 1 is patentable over *Delme* and *Tung*, whether considered in combination or independently, by at least reciting:

> ~~The ternary block copolymer with penta-block structure~~ A pentablock copolymer represented by the formula (1), wherein the molecular weight is 50,000 to 400,000, pB has more than 70% of 1,4 structure, the content of pS is 5 % to 50 % by weight and pB and pI are in a weight ratio of $pB/pI \geq 1$.
>
> pS-pI-pB-pI-pS (1)
>
> Wherein, pS is vinyl aromatic polymer, pB is polybutadiene and pI is polyisoprene.

In contrast, *Delme* discloses a linear tetrablock copolymer, usable in road marking compositions additionally containing a hydrocarbon resin for improving the powder grinding or high-shear stirring.

The tetrablock copolymer of *Delme* comprises four blocks independently selected from polystyrene, polyisoprene, and polybutadiene, wherein the tetrablock is represented by the formula S-I-S-B, S-I-S-I, S-B-S-B or S-B-S-I wherein S is polystyrene, I is polyisoprene and B is polybutadiene.

The contents of the pB(butadiene) block and pI(isoprene) block used in *Delme* are 10 to 90% based on total weight of copolymer, respectively.

As claimed, the copolymer of the present invention is pentablock copolymer having isoprene block inserted into S-B-S structure(not at the end of the structure). In contrast to the present invention, the copolymer of *Delme* is a tetrablock copolymer having butadiene or isoprene block at the end of S-B-S (or S-I-S). Accordingly, the copolymer of the present invention is clearly different from the copolymer of *Delme* in terms of its structure.

In connection with the contents of pB block and pI block used in both inventions, the contents used in *Delme* is 10 to 90% based on total weight of copolymer, respectively; that used in the present invention is pB/pI≥1.

Meanwhile, in the Comparative Example 1 of the present invention (see page 13 of the specification as filed), a compound similar to the copolymer of *Delme* was prepared and an experiment was performed to compare the physical properties of the compound and the copolymers prepared in Examples of the present invention. The physical properties are shown in Table 1 (see page 14 of the specification as filed). The copolymers of the present invention exhibits improved Tensile properties which are different properties required for powder grinding or high-shear stirring properties by the copolymers as suggested in *Delme*.

For your reference, tensile properties of some block copolymers are listed in the following Table.

structure	Contents(weight by percent)			Tensile strength (kgf/cm2)
	styrene	isoprene	butadiene	
S-I-B-I-S	15	35	50	**126**
	15	50	35	**207**
	20	20	60	**180**
	20	40	40	**200**
S-(I/B)-S*	15	25	60	40
	15	35	50	61

*(I/B) is random copolymerized diene block.

The Examiner pointed out that the present invention and *Delme* are similar to each other in terms of the constitution. Of course, both inventions share the provision of a copolymer containing polystyrene, polyisoprene and polybutadiene components. However the block copolymer of the present invention shows much higher tensile strength that those of comparable block copolymers with the some components as shown in above table. Furthermore, the tetrablock copolymer of *Delme* provides powder grinding or high-shear stirring by being readily melted and mixed with hydrocarbon resin, whereas vinyl aromatic block copolymer of the present invention provides improved mechanical properties such as Tensile Strength, Elongation rate and 300% Elasticity, which are not disclosed in *Delme* at all. Accordingly, the claimed invention is clearly patentable over *Delme* in terms of the constitution and the effects of both inventions.

Tung relates to block copolymers utilizing a mixture of cis- and trans-isomers of 1,3-pentadiene, having improved heat and exposure stability, and comprising the block copolymer composition of *Tung*, which comprises (a) at least two blocks; and (b) at least one block polymerized from a mixture of cis and trans-isomers of 1,3-pentadiene and a cis-isomer of 1,3-pentadiene polymerizing amount of polymerization promoter continuously or incrementally added during the polymerization of the 1,3-pentadiene mixed isomer mixture, the polymerization promoter consisting essentially of a vinyl-substituted aromatic hydrocarbon.

The block copolymer of *Tung* is represented by the formula S-(P/I), S-(P-S)-S, (S/P)-(P/S)-(S/P), (S/P)-(P/S)-P-B-P-(P/S)-(S/P), (S/P)-(P/S)-B-(P/S)-(S/P), (S/P)-(P/S)-P-(P/S)-(S/P), S-(P/S)-(P/S)1-(P/S)2, S-(P/S)-(P/S)1-(P/S)2-(P/S)3 as described in claim 5 thereof, wherein B is conjugated diene homo(co)polymer, S is a homopolymerized vinyl-substituted aromatic hydrocarbon, P is poly(1,3-pentadiene) polymerized from a mixture of mixed isomers of 1,3-pentadiene, S/P is a copolymer having a polymerized vinyl-substituted aromatic hydrocarbon(major) and a polymerized mixture of mixed isomers of 1,3-pentadiene(minor), P/S is a copolymer having a polymerized vinyl-substituted aromatic hydrocarbon(minor) and a polymerized mixture of mixed isomers of 1,3-pentadiene(major), and subscripts of 1 to 3 refer to decreasing amounts of polymerized mixed isomers of 1,3-pentadiene.

The claimed invention and *Tung* share the preparation of pentablock in common. However, the pentablock used in the claimed invention is particularly represented by the formula S-I-B-I-S having an isoprene block between PS and PB of block S-B-S.

Accordingly, the copolymer of the claimed invention is considerably different from that of *Tung* in terms of its structure.

As shown in the Table above, the copolymers of the claimed invention exhibited enhanced tensile strength of 126 to 200 kgf/cm, whilst the random copolymer of PB and PI copolymer was very poor in tensile strength (40 to 61 kgf/cm2).

The results indicate that not only the simple composition but also the block sequence is critical to enhancement of the mechanical properties. In fact, the improvement of mechanical properties is originated from the consideration of the principle of phase separation as described in the present invention. Therefore the copolymer of the claimed invention is very different from the copolymer of *Tung* in terms of its structure. In addition, the copolymer of the present invention exhibits a high tensile strength compared to the copolymer of *Tung*. In conclusion, claim 1 is patentable over *Tung*.

The Examiner pointed out that a process of producing a block copolymer in *Delme* as disclosed by *Tung* for making a penta-block copolymer because *Delme* discloses a sequentially

adding initiator and desired monomer of butadiene or isoprene such that the linear block copolymer can have at least five block units and the end of the penta-block copolymer can have a polystyrene block, and thus the present invention is unpatentable over the combination of *Delme* and *Tung*.

The use of a mixture of cis/trans isomers of 1,3-pentadiene in *Tung* enables the preparation of a copolymer having a polystyrene end block and being substituted for all or some butadiene or isoprene blocks by the mixture of cis/trans isomers of 1,3-pentadiene. However, the butadiene or isoprene block used in *Delme* leads to the preparation of copolymer having polybutadiene block or polyisoprene block end. However, the improvement of physical properties of the penta block copolymer can be obtained by the unique block sequence of pS-pI-pB-pI-pS as specified in the present invention, not by the simple adaptation of components or extending the number of blocks. The importance of the block sequence is based on the theory of phase separation, which was not mentioned in *Delme* or *Tung*. In conclusion, the combination of *Delme Tung* cannot yield the present invention.

Furthermore, the contents of butadiene block or isoprene block used in *Delme* is 10 to 90% based on total weight of copolymer, respectively. However, the contents of butadiene block or isoprene block used in *Tung* doesn't have any disclosed range. Accordingly, although *Delme* and *Tung* are combined, $pB/pI \geq 1$ of the claimed invention cannot be obtained.

As discussed above, since the addition of the mixture of cis/trans isomers of 1,3-pentadiene used in *Tung* to the reaction shown in *Delme* cannot yield a pentablock copolymer having a polystyrene block end, the combination of *Delme* and *Tung* cannot yield the claimed invention. As such, Applicants respectfully submit that claim 1 is patentable over the cited references. Further, dependent claims 2 – 5 are patentable over the cited references at least by virtue of their dependency.

Claim Rejections – 35 U.S.C. §102(b)

In sections 3 and 4 of the Office Action, the Examiner rejected claims 6 – 11 under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,399,627 to Diehl et al. In response, Applicants are canceling claims 6 – 11.

Claim Rejections – 35 U.S.C. §112

In section 5 of the Office Action, the Examiner rejected claims 1 – 5 under 35 U.S.C. §112, second paragraph, as being indefinite. Accordingly, Applicants are amending claims 1 – 5 for purposes of clarity. The title is similarly being amended.

PATENT
Attorney Docket No.: 61282.00005

As only patentable claims remain pending, Applicants respectfully request that a timely Notice of Allowance be issued in this case.

Respectfully submitted,
Kwanyoung LEE et al.

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By _____
Aaron Wininger
Attorney for Applicants
Reg. No. 45,229

Squire, Sanders & Dempsey L.L.P.
600 Hansen Way
Palo Alto, CA 94304-1043
Telephone (650) 856-6500
Facsimile (650) 843-8777

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Aaron Wininger